

PRELIMINARY NOTE ON THE REMARKABLE,
SHORTENED DEVELOPMENT OF AN AUSTRALIAN
SEA-URCHIN, *TOXOCIDARIS ERYTHROGRAMMUS*.

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(Communicated by Dr. S. J. Johnston.)

During a visit to Australia in August-October, 1914, I was very anxiously looking for opportunities for studying the development of Australian Echinoderms in continuation of the researches carried out in Japan, in April-July of the same year. It proved, however, to be a very unfavourable time of the year for that purpose, not a single species of Echinoderms having ripe sexual products—except the small *Asterina exigua*, which, as has been made known by Whitelegge, has care of its brood, like the European species, *Asterina gibbosa*. I had then to alter my plans to some extent, and went to New Zealand in the beginning of November, one month earlier than originally planned. In that way, I could arrange for a stay in Sydney during the later part of the summer, February-March, at which time it might be expected that the majority, at least, of the littoral Echinoderms of Port Jackson would prove to have ripe sexual products.

To my surprise, even this turned out to be a little too early in the season for my object. Of the Echinoderms, of which material in any sufficient quantity was available, only one species—always *Asterina exigua* excepted—was really in the breeding season now, namely, *Toxocidaris erythrogrammus*. Of the three other common littoral sea-urchins, one, *Centrostephanus Rodgersii*, was still very far from having ripe sexual products; it must, evidently, have its breeding season in the middle of the winter; the two others, *Phyllacanthus parvispinus* and *Holopneustes purpurascens*, were nearly ripe, but not quite. Among the other Echinoderms, of which material was available, not one was found

with quite ripe eggs. It was thus alone *Toxocidaris erythrogrammus*, the development of which could be studied. But this proved, in return, to be quite unusually interesting, so that it was thought advisable to publish this short preliminary account of it.

The eggs of *T. erythrogrammus** are large, ca. 0.5 mm. in diameter, red-yellowish, and quite intransparent, evidently full of a yolk substance; they are *floating at the surface of the water*, a case not hitherto observed in Echinoderms. The cleavage is total, and, in the first stages in any case, quite regular. The gastrulæ are not bound to the surface, but swim free in the water, with the usual rotating movement. The aboral end, which evidently contains the main part of the yolk, and thus is the lighter end, is always turned upwards and remains so during the whole of the development.

Just above the oral end, a slight widening of the body of the body of the embryo occurs, though not quite constantly, it seems. This may perhaps represent a rudiment of the postoral larval processes; but they do not develop further, and there is no indication of the typical Pluteus-shape at all; and, moreover, so

* In Th. Whitelegge's "List of the marine and freshwater Invertebrate Fauna of Port Jackson and neighbourhood" (1889), this species is mentioned under the name of *Strongylocentrotus erythrogrammus*. As I have shown in my work on the Echinoidea of the Danish Ingolf-Expedition (Part i., 1903), the genus *Strongylocentrotus* must be restricted to a certain group of northern species, the species *dræbachiensis* being the type of the genus; the species *erythrogrammus*, together with several other species from the Pacific, must be referred to the genus *Toxocidaris*. It is quite probable that the name *erythrogrammus* will ultimately have to be changed. The species figured under that name by Valenciennes (Voyage de la Frégate Venus) is evidently the South American species *Loxechinus albus*, and not the common Australian species. Which name should then eventually be substituted for *erythrogrammus*, I cannot say at present, having, of course, no access to literature here. I may take the opportunity to point out here that the other species of *Strongylocentrotus* mentioned in Whitelegge's List, *Str. tuberculosus*, is no true *Strongylocentrotus* either; and, moreover, it is by no means specifically identical with the common Japanese *Toxocidaris tuberculatus*. What the correct name of this species will be, I am not prepared to say at present, having not had the necessary literature or time for investigating this matter.

far as I have been able to ascertain on the quite intransparent living embryo, there is no trace of a larval skeleton.

There is a general ciliation of the whole body of the embryo, but no special ciliated bands. A ring of red pigment is formed round the mouth, and gradually more or less of a reddish pigment develops all over the body. Some specimens, however, have scarcely any pigment at all; such probably give rise to the very light-coloured specimens, which are often found among the otherwise generally dark-coloured specimens of this species.

The young sea-urchin develops on one side of the embryo, just above the mouth, and here the primary tube-feet are soon seen to protrude. The aboral part of the body, which serves as a reservoir of nourishment for the embryo, gradually shortens, and ultimately becomes completely overgrown by the young urchin, and enclosed within its body. The first spines to appear are of the trifid, embryonal type; but soon the spines of the usual, pointed shape, make their appearance.

When the first rudiments of the sea-urchin begin to appear, the embryo generally sinks to the bottom, remaining there in the usual position, mouth downwards; many specimens, however, remain swimming until the metamorphosis is nearly completed; especially a number of specimens remained at the surface, at the contact-line between the water and the glass. The whole metamorphosis is completed in the course of 4-5 days.

The details of the formation of the enterocoel and all the internal transformation-processes, upon the whole, can only be studied by means of sections. That must be postponed till after my return to Copenhagen. Likewise, the development of the skeleton of the young urchin will have to be studied carefully later on, the conditions, under which I had to carry out my experiments, being far too unfavourable for such minute and partly very difficult research.

This is the most reduced development hitherto known in any Echinoid with free-swimming embryos. The development of *Laganum decagonale*, described in my paper "On the development of some Japanese Echinoderms" (Annot. Zool. Japonenses, Vol. viii., 1914), is not nearly so reduced, the typical larval shape

being there still distinctly recognisable, But I feel quite convinced that this will not be a unique case. I think I may predict rather safely that a quite similar shortened development will prove to obtain in two other of the common Echinoids of Port Jackson, namely in *Phyllacanthus parvispinus* and *Holopneustes purpurascens*. In both of these, the eggs are large and intransparent, and float at the surface. (I succeeded in finding a few ripe eggs in a specimen of *Phyllacanthus*, and got them fertilised; but, unfortunately, none of the embryos obtained survived the Gastrula-stage). It is remarkable to find such a large percentage of the littoral Echinoids of the New South Wales coast having such an aberrant type of development, and one can scarcely help thinking that the natural conditions there may account for that. But which are the real factors to which such influence on the development is due, nobody, of course, can say, at present at least.

I may still mention that *Holopneustes purpurascens* shows a very marked difference in the coloration of the gonads of the two sexes; the male genital organs are bright pink, the female gonads dark olive-coloured. The black intestine also affords a very conspicuous contrast in colour to the generally pink test and spines. Judging from the different size and colour of the eggs in the same gonad, this species would appear to breed twice in the season.

On board s.s. "Sonoma,"

The Pacific, 2°S., 172°W., March 20, 1915.

Postscript: added June 4th, 1915—Lyman Clark assigns the name *Heliocidaris* to the group of species to which I have applied the name *Toxocidaris*. As I cannot, of course, go deeper into these matters of nomenclature here [Honolulu], I shall, at present, at least, keep the name *Toxocidaris*, leaving the possible change till later, when I have had the opportunity of carefully considering Clark's reasons for this use of the name *Heliocidaris*.